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# ACTUATING DEVICE WITH PRESSURE RESISTANT DRIVE CHAIN
# [STELLVORRICHTUNG MIT EINER DRUCKSTEIFEN ANTRIEBSKETTE]

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Description

[0001] The invention concerns an actuating device with a compression resistant drive chain pursuant to the preamble of claim 1.

[0002] An actuating device known from DE 33 15 779 C2 has a drive with a compression resistant connector chain, whose chain links provided with outer straps are connected by means of respective pivot pins and locking bolts transversely to the chain strap direction. An advance force is applied on these pivot pins with a sprocket wheel provided for driving the chain and the locking bolts provided for reinforcing the chain can thereafter be locked in the respective locking position by means of a guiding mechanism acting transversely to the advance direction. Displaceable locking bolts are also moved transversely to the advance direction of the chain by means of a guiding mechanism in the solution proposed by DE 1 046 422, so that the chain assumes a compression-resistant service position only when this displacement of the locking bolts has taken place. In the block chain according to DE 18 55 588 U is proposed a conveyor system for horizontally conveying goods, wherein the traction force of a drive wheel can be transmitted only via pivot pins connecting respective links

of the chain. According to DE 199 83 305 T1 is proposed a connecting part having an internal chain, which is provided with a jacket forming a channel-shaped elongated longitudinal piece. For this reason, these compression-resistant drive chains require a disadvantageously large installation space and are exposed to high wear due to a multitude of highly stressed articulated parts.

[0003] It is an object of the invention to create an actuating device with a compression-resistant drive chain, which can be assembled with little technical effort from a structure of chain links that requires only few individual components, which can be used for different compressive forces for usage conditions demanding a small spatial requirement, and which makes possible a long-term stable application for assemblies with different working functions.

[0004] The invention attains this object with a drive chain having the features of claim 1. Reference is made to dependent claims 2 to 20 with regard to other essential embodiments of the drive chain and actuating devices having the same.

[0005] The drive chain according to the invention has adjoining pivoting elements directly in the region of the sliding surfaces as essential functional components for force transmission, so that an assembly similar to a rigid

chain predominantly for any desired utilization can be achieved in actuating, lifting, and positioning devices. A system with various applications and simple structure with compression-resistant chain is created with easy to produce functional parts and a driving component of a driving element allocated to a sprocket wheel or the like. The compression-resistant chain can be advantageously used as an articulated mast, which requires comparatively small installation space with regard to the actuating loads that it can absorb and the possible displacements.

[0006] Further details and advantageous embodiments of the invention are disclosed in the following description and the drawings, in which several exemplary embodiments of the drive chain according to the invention and an actuating device are shown. In the drawings:

Fig. 1 shows a lateral view of an actuating device configured as a lifting table with a compression-resistant drive chain provided as drive;

Fig. 2 shows a lateral view similar to Fig. 1 with the lifting table in an upper lifting end position;

Fig. 3 shows a plan view of the drive assembly of the lifting table according to Fig. 2 without its upper table slab;

Fig. 4 shows an enlarged lateral view of a partial region of the compression-resistant drive chain in a working position similar to that of Fig. 2;

Fig. 5 shows a frontal view of the drive chain according to Fig. 4;

Fig. 6 shows a detail drawing of a guidance part that accommodates the drive chain in the actuating device according to Fig. 1;

Fig. 7 shows a lateral view similar to Fig. 6 with the drive chain accommodated in a deflecting groove of the guiding part;

Fig. 8 shows a lateral view of the sprocket wheel engaging in the drive chain;

Fig. 9 shows a plan view of the sprocket wheel according to Fig. 8;

Fig. 10 shows a perspective representation of a first pivoting element for the chain link that forms the drive chain;

Fig. 11 shows a perspective representation of a second pivoting element of the chain link;

Fig. 12 shows a perspective representation of a strap part provided for connecting the pivoting elements or the chain links;

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Fig. 13 shows a perspective representation of a second embodiment of the drive chain with pivoting elements with bolt connections arranged in two parallel rows;

Fig. 14 shows a lateral view of the drive chain according to Fig. 13;

Fig. 15 shows a plan view of the chain according to Fig. 14;

Figs. 16 to 19 show respective detail drawings of the individual parts in form of pivoting elements provided for the multipart drive chain according to Figs. 13 to 15 and the respective strap parts similar to those of Figs. 10 to 12;

Fig. 20 shows a plan view of a sprocket wheel for the multipart drive chain according to Fig. 13;

Fig. 21 shows an exploded representation of a single-link drive chain similar to that of Fig. 5 with modified force application and adapted strap part;

Fig. 22 shows a representation similar to that of Fig. 21 with a multi-link embodiment of the simply structured chain;

Fig. 23 shows a lateral view similar to that of Fig. 7 with the drive chain according to Fig. 22 in connecting position; and

Fig. 24 shows a frontal view of the guiding guide pulley of the drive chain according to Fig. 23.

[0007] In Fig. 1 is shown an actuating device identified overall with reference numeral 1, wherein it becomes clear when it is considered together with Fig. 2 that the actuating device 1 is provided as an assembly of a lifting table 2, which can be displaced steplessly into the shown lifting positions. The actuating device 1 is provided therein with a drive chain 3 having chain links 4 pivotable by means of articulated links, which can be driven into a compression-resistant position (Fig. 2) and can be returned from this position (Fig. 1) by means of a sprocket wheel 5 driven by a motor M.

[0008] Fig. 4 clarifies the embodiment according to the invention of the compression-resistant drive chain 3 by means of an enlarged cutout representation. The drive chain 3 has chain links 4, 4', 4", which are formed by respectively two pivoting elements 6 and 7 forming a continuous row. From this results that the respectively first pivoting element 6 is adjacent, on the one hand, to the allocated second pivoting element 7 and the coordinate chain link 4' is articulated, on the other hand, in such a way with its second pivoting element 7' that a continuous

in-line configuration of the alternatively adjacent pivoting elements 6, 7, 6′, 7′ is formed.

[0009] The separate observation of the pivoting elements 6 and 7 based on the chain link 4 clarifies that the components are directly adjacent. Complementing sliding surfaces G having an arched contour 8 (Figs. 10 and 11), which can be positioned one against the other, are provided in this contact region likewise between the pivoting elements 6 and 7 as well as also toward the coordinate chain link 4′, and a direct articulated connection of the pivoting elements 6 and 7 similar to a sliding hinge is formed therewith.

[0010] A drive component (Fig. 5), which is identified overall with reference numeral 9, is provided in order to apply the drive force F at least on one of the two pivoting elements 6, 7 per chain link 4, 4′. The pivoting elements 6, 7 can be engaged with this drive component 9 by means of a gear tooth profile 10 of a sprocket wheel 5 shown in Figs. 8 and 9 and can be displaced into a compression-resistant position (Fig. 4, left side) and can be returned from this working position (Fig. 2) into the initial position (Fig. 1) by means of a counterrotating drive.

[0011] The drive phase represented in Fig. 4 shows schematically that a torque A (Fig. 7) acting as actuating

force can be applied via the respectively engaged drive component 9 by means of the single-piece pivoting elements 6 and 7, and this actuating force acting on the pivoting elements 6, 7 is only absorbed within the region of the adjacent sliding surfaces G (shown by means of several arrows F) and is guided into the chain links arranged upstream of the driven pivoting element, so that the drive force F' can be diminished at an intermediate piece 12.

[0012] It is understood that, with the pivoting elements 6, 7, the respectively acting counterpressure forces according to arrow D can also only be absorbed in the region of the adjacent sliding surfaces G when the compression-resistant working position of the chain 3 (Fig. 2) is reached. This concept of the pivoting element chain makes possible the design of the most different actuating devices 1, wherein the driving assembly with the chain 3 is advantageously conceived in such a way that the pivoting elements 6, 7 receive additional support and guidance corresponding to the provided adjustment travel by means of the guiding part 13 represented in Fig. 6 when they are displaced into the compression-resistant working position. It is also conceivable to support the pivoting element 6 and 7 arranged in a row only in a guiding channel (not shown) and to apply the advance movement in such a way via

the driving components 9 that the pivoting elements are displaced corresponding to the advance direction predetermined by the guiding channel.

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[0013] In the shown embodiment, the pivoting elements 6 and 7, which can be pivoted relative to each other in the region of the complementing arched contour 8, can be produced and assembled as single-piece components in such a way that a working plane E (Fig. 5) through which reach the driving components 9 configured as pressure bolts 14 is defined corresponding to the average longitudinal plane of the chain 3. This constructive design of the pivoting elements 6 and 7 makes possible an application-specific adaptable displacement of the pivoting elements 6 and 7 within the working plane, wherein compression-resistant working positions can be achieved also starting from a stretched 0° initial position by means of the linear displacement (not shown).

[0014] A displacement and deflection of the pivoting elements 6 and 7 into working positions (Fig. 2) changed by up to more than 180° can be carried out when the shown sprocket wheel 11 is used as drive. The pivoting elements 6, 7 are engaged in such a way by the sprocket wheel 11 provided as drive that the pivoting elements of the link 4'

located in the stretched chain strand (Fig. 4, left side) of the chain 3 are displaced in straight direction running essentially tangential to the periphery of the sprocket wheel 11 (Fig. 2).

[0015] In accordance to the active guidance (in Fig. 2) by means of scissors arms 15 and 16 of the lifting table 2 as well as the guiding part 13, 13' (Fig. 3), the pivoting elements 6, 7 can be displaced with an arched curvature 8 (Fig. 7) that follows the periphery of the sprocket wheel 11, wherein the chain strand T at the output end retains the straight alignment. This displacement of the chain strand T at the output side is secured within the region of the actuating device 1 in the manner of a positive guide.

[0016] The individual representations of the pivoting elements 6 and 7 according to Figs. 10 and 11 clarify a preferred design of the individual parts. The second pivoting element 7 has therein respective connecting attachments 17 and 18 arranged in mirror-image, in whose region a retaining pin 19 (Fig. 5), which connects the pivoting elements 6 and 7 to each other or to the following chain link, engages through a through bore 20.

[0017] Strap parts 21, which are each shown in individual representation in Fig. 12, are provided (on both

sides of the working plane E, Fig. 5) on the second pivoting element 7 (Fig. 11), with which the connection to the pivoting element 7 is created merely in the region of the retaining pin 19, and the second retaining pin 19 forms, on the other hand, a connection to the coordinate chain link. An articulated connection is created with this connection of the retaining pins 19, which is independent and predominantly stress-free from the hinge-like support-pivot connection, which absorbs the actuating forces within the region of the respective sliding surfaces G of the arched contour.

[0018] The joint observation of Figures 10 to 12 with Figs. 4 and 5 clarifies that the strap part 21 has respectively one receiving bore 22 comprising the pressure bolt 14 and a insertion opening 20', which connects the coordinate pivoting elements or chain links by means of retaining pins 19 to the chain 3, is provided respectively in longitudinal direction on both sides of this bore 22.

[0019] This design of the drive chain 3 formed by identical parts has mutually opposite strap parts 21 (Fig. 5) on the outside and these engage in this embodiment with the respective first pivoting element 6 respectively in the center of the region of a transverse axis 23, in which the driven pressure bolt 14 runs.

[0020] The first pivoting element 6 (Fig. 10) is provided with concavely shaped sliding surfaces G, into which is guided the second pivoting element 7, which has the respective convexly shaped sliding surfaces G'. These convex sliding surfaces G of the second pivoting element 7 are provided as partial region of an S-shaped arched contour 8 and the respective retaining pin 19 bearing the strap part 21 engages through the second pivoting element 7 (Fig. 4) in the upper region of this S-contour.

[0021] In a practical embodiment, the first pivoting element 6 is also configured with an S-shape that complements the second pivoting element 7 in the region of its concave arched contour 8. It is also conceivable that the parts 6 and 7 have only the upper arched contour 8 and can therefore connect to a flat contact surface (not shown) on the bottom.

[0022] The guiding part for the drive chain 3 is shown in more detail in Figs. 6 and 7, wherein the guiding part 13 has a guiding groove 24, which accommodates the pressure bolt 14. The represented drive chain 3 is resistant to transverse forces in any case in its respective movement phase, so that the actuating device 1 complies with the corresponding security requirements.

[0023] A drive chain 3′ in assembled position (Figs. 13 to 15) with its pivoting elements 6′ and 7′ or strap parts 21′, 21″ and the allocated sprocket wheel 11′ with gear teeth 10′ is represented in detail in Figs. 13 to 20. This drive chain 3′ consists of several rows of pivoting elements 6′ and 7′ arranged at intervals and aligned in rows parallel to the longitudinal direction of the chain, wherein these two parallel rows are transversely connected by means of an elongated driving component 9′ in form of a pressure bolt 14. A structure is created with this expansion of the drive chain 3, which can also have further parallel rows (not shown), with which greater driving forces can be transmitted, wherein the concept described with regard to the single-link drive chain 3 (Fig. 4) is basically retained.

[0024] A further simplified embodiment of the drive chain 3″ is shown in Fig. 21, wherein the latter is provided with the individual parts that form the continuous rows similarly as the single-link chain of Fig. 5, to which respective outer strap parts 21″ are allocated. The strap

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parts 21″ are arranged in such a way as connector between the respective two pivoting elements 7″ that the interposed first pivoting element 6″ can be overlapped on the outside.

In this way is achieved that the pivoting elements 6″ in longitudinal direction of the chain are guided as loose parts with respect to the respective arched contour 8 or the sliding surfaces G, G′ of the respectively coordinate second pivoting elements 7″ and the sliding surfaces G, G′ are in contact when the advance force F is applied.

[0025] This drive chain 3″ according to Fig. 21 is driven via at least two pressure bolts 14′, which engage in pairs through the strap parts 21″, in such a way that the actuating force F (similarly as in Fig. 4) is transmitted directly to the pivoting elements 7″ and from these to the pivoting elements 6‴. The strap parts 21‴ predominantly integrated as loose parts in the chain 3″ are merely provided to fix the pivoting elements 6‴ in transverse direction, while the links are connected overall by means of pressure bolts 14′. These pressure bolts 14′ are provided with respective roller bearings 26, which are supported in particular in the region of the guiding grove 24 (Fig. 24) of the guiding part 13 and exert a corresponding counterpressure when the pivoting elements 6‴ and 7‴ are deflected (similarly as in Figs. 6 and 7).

[0026] A further embodiment of the chain 3″ is shown in Fig. 22, wherein the latter is configured with several links based on the single-link basic shape (in Fig. 21) by

means of at least one coordinate row of components (similarly as in Figs. 13 to 20). The pivoting elements 6''' and 7''' correspond in shape to the parts in Fig. 21, wherein a respective spacing pin 25 is provided at least between the pairs of second pivoting elements 7''' lying opposite to the central longitudinal plane E' in this multi-link component row. In the shown embodiment, one of the spacing pins 25' is also provided between respectively opposite-lying first pivoting elements 6''' in order to prevent their displacement toward the plane E'. The pivoting elements 6''' are overlapped on the outside by the strap parts 21'''. During the assembly of the individual parts, the chain 3" is connected in transverse direction in that the roller bearings 26 are fixed on the pressure bolts 14', for example, by means of a corresponding pressure fittings or the like.

[0027] The components utilized according to Figs. 21 and 22 are conceived as an assembly, with which the production effort of the respective drive chain 3" is reduced. Less wear of the system is also achieved at the same time due to the lower amount of components. An optimization of the component connection by means of the two pressure bolts 14' is achieved in that the strap part 21''' in the region of its connecting bores 20'

predetermines a space K, with which an optimal force application is possible (Fig. 23, Fig. 24) in the region of the drive gear wheel 5. The optimal force application during the advance or return movement is improved by means of the arrangement in pairs of the pressure bolts 14′.

[0028] The pressure bolts 14′ are introduced in the region of the straps 21′′′ through a play fit into the respective bore 20′ and a fit, for example, a play fit adapted in its tolerance to the chain size can likewise be advantageously provided in the region of the respectively allocated bore 20 in the pivoting element 7′′′. The pressure bolt 14′ makes contact at least in arch shape in its working position on the inner wall of the bore 20, so that the strap 21′′′ does not absorb any pressure or traction forces and these are transferred respectively only via the pressure bolts 14′ to the series of elements 6′′′ and 7′′′.

Patent Claims

1. An actuating device with a compression-resistant drive chain (3, 3′, 3″), whose chain links (4, 4′, 4″) having strap parts (21, 21′, 21″) and connected by means of articulated parts can be displaced by means of a driven sprocket wheel (5, 5′) into a compression-resistant position and can be returned from said position,

characterized in that said chain links (4, 4′, 4″, 4‴) forming a continuous row have two pivoting elements (6, 7; 6″, 7″; 6‴, 7‴), which form respective joints in the shape of complementing as well as interposed contacting sliding surfaces (G, G′) with an arched contour (8) in the longitudinal direction of the chain and also with respect to the coordinate chain link (4, 4′, 4″, 4‴), a drive component (9, 9′; 14, 14′) is provided on at least one of the two pivoting elements (6, 7; 6′, 7′; 6‴, 7‴) per chain link (4, 4′, 4″, 4‴), and the pivoting elements can be displaced therewith by means of a gear tooth profile (10, 10′) on the sprocket wheel (5, 5′) into a compression-resistant position and can be returned from said position.

2. The drive chain of claim 1, characterized in that a torque (A) acting in the driving phase as actuating force can be absorbed by means of single-piece pivoting elements (6, 7; 6″, 7″) via the respectively engaged driving component (9), and this actuating force (F) can be applied only in the region of the contacting sliding surfaces (G, G′) in the chain links (4″) arranged upstream of the driven pivoting elements (6, 7).

3. The drive chain of claim 1, characterized in that effective counterpressure forces (D) can only be absorbed in the region of the contacting sliding surfaces (G, G′)

with the pivoting elements (6, 7; 6″, 7″, 6‴, 7‴), respectively, when the compression-resistant working position of the chain (3, 3″) is reached.

4. The drive chain of one of the claims 1 to 3, characterized in that the pivoting elements (6, 7; 6″, 7″; /5 6‴, 7‴) coact with a guiding part (13), which becomes effective when it is displaced into the compression-resistant working position.

5. The drive chain of one of the claims 1 to 4, characterized in that the pivoting elements (6, 7; 6″, 7″; 6‴, 7‴), which can be pivoted with respect to each other, define a working plane (E, E′), through which engage vertically the driving components (9) configured as pressure bolts (14) in the region of the complementing arched contours (8).

6. The drive chain of one of the claims 1 to 5, characterized in that the pivoting elements (6, 7; 6″, 7″) in the working plane (E) can be displaced from a stretched 0° initial position up to a driving position modified by more than 180°.

7. The drive chain of claim 6, characterized in that the pivoting elements (6, 7; 6″, 7″) can be engaged in such a way by the sprocket wheel (5, 5′) provided as drive that

the stretched chain (3, 3′) can also be displaced in a straight alignment (working strand T) running tangentially with respect to the periphery of the sprocket wheel (5, 5′) in the working position.

8. The drive chain of claim 6, characterized in that the pivoting elements (6, 7; 6″, 7″) can be displaced with an arched curvature that follows the periphery of the sprocket wheel (3, 3′) and an output-side chain strand (T) has a straight alignment.

9. The drive chain of one of the claims 1 to 8, characterized in that the pivoting elements (6, 7; 6″, 7″) located in the output-side chain strand (T) in the driving phase can be positively guided when displaced in straight alignment (guiding part 13).

10. The drive chain of one of the claims 1 to 9, characterized in that the pivoting elements (6, 7; 6″, 7″) have respectively connecting attachments (17, 18) with through openings (20) at their ends in the region of the joints formed by the sliding surfaces (G, G′), in whose region mutually connecting retaining pins (19) are provided, which respectively connect the two pivoting elements (6, 7; 6″, 7″) or the following chain link.

11. The drive chain of one of the claims 1 to 9, characterized in that the pivoting elements (6, 7; 6″, 7″)

have strap parts (21, 21′), which connect these to each other as well as to the following chain link and form thus an articulated connection, which is independent from the sliding surfaces (G, G′) by means of the retaining pins (19) running transversely to the longitudinal direction of the chain.

12. The drive chain of claim 11, characterized in that the strap part (21) has a receiving bore (22) that comprises the pressure bolt (14) and an insertion opening (20′) is provided on both sides thereof, which connects the coordinate pivoting elements (6, 7) or chain links to the chain by means of the retaining pin (19).

13. The drive chain of one of the claims 1 to 12, characterized in that the centrally engaged first pivoting elements (6, 6′) lying opposite the strap parts (21) on the outside are provided with concavely shaped sliding surfaces (G) on both sides of their transverse plane formed by the axis (23) of the driven pressure bolt (14) and convex shaped sliding surfaces (G) of the coordinate second pivoting elements (7) are guided alongside these in the longitudinal direction of the chain.

14. The drive chain of claim 13, characterized in that the convex sliding surfaces (G′) of the second pivoting elements (7) are provided as partial region of an S-shaped

arched contour (8) and the respective retaining pin (19) bearing the strap part (21) engages through the second pivoting element (7) in the upper region of this S-contour.

15. The drive chain of claim 13 or 14, characterized in that the first pivoting element (6) has an S-shape that complements the second pivoting element (7) in the region of its concave arched contour (8).

16. The drive chain of one of the claims 1 to 15, characterized in that the guiding part (13) coating with the pivoting elements (6, 7) has a guiding groove (24) that accommodates the outer edges of the pressure bolt (14).

17. The drive chain of one of the claims 1 to 14, characterized in that the chain structure (3) is formed by several spaced rows of pivoting elements (6", 7") aligned in parallel rows in longitudinal direction of the chain and these parallel rows are transversely connected by means of an elongated driving component (9').

18. The drive chain of one of the claims 1 to 17, characterized in that the chain links (4''') have respective pairs of strap parts (21''') in the continuous row of a single-link chain, which overlap the respective first pivoting element (6''') on the outside, so that the pivoting elements (6''') can only be applied as loose parts

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on the respective arched contour (8) of the two coordinate second pivoting elements (7’’’) and the actuating forces (F, F’) can be transmitted directly to the pivoting elements (6’’’, 7’’’) via the respective strap parts (21’’’) with a pressure bolt (14’) engaging through a play fit.

19. The drive chain of one of the claims 1 to 18, characterized in that said chain (3’’’) can be expanded to many links from the single-link basic shape by means of at least one coordinate component row and in this way at least one spacing pin (25) is provided between the pairs of second pivoting elements (7’’’) lying opposite each other.

20. An actuating device having a drive chain according to one or several of the claims 1 to 19, characterized in that the drive chain (3, 3’, 3”, 3’’’) is provided as a component of a lifting table (2), whose scissors (15, 16) can be spread by means of the drive chain (3, 3’, 3”, 3’’’) displaced by the drive motor (M) into compression-resistant straight alignment.

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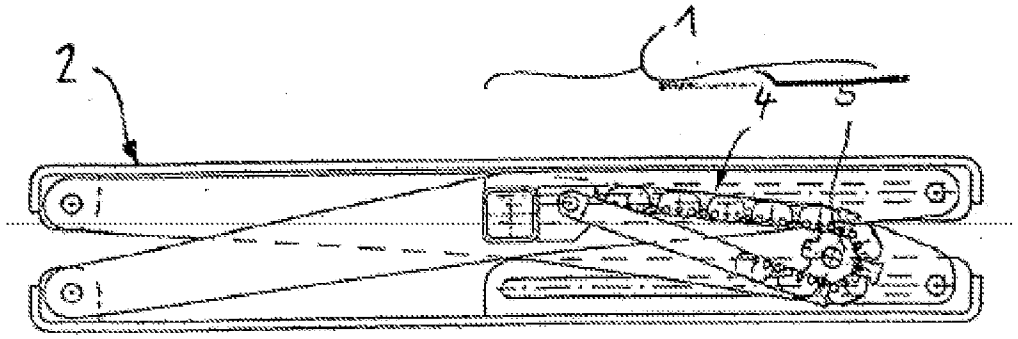


Fig. 1

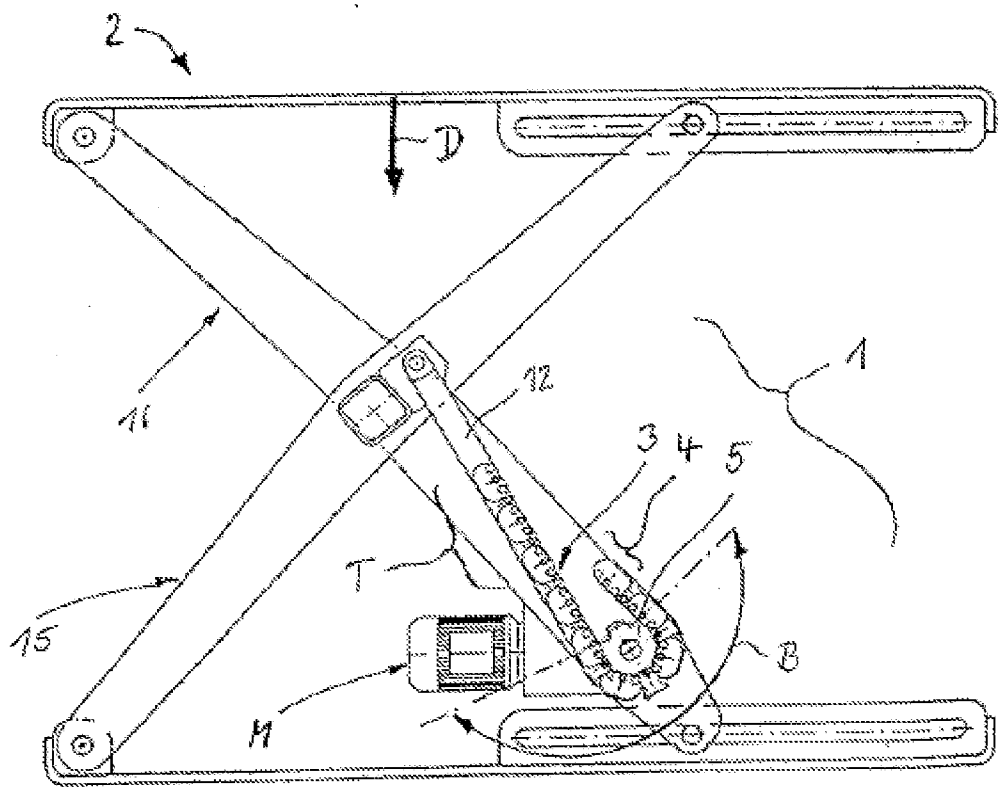


Fig. 2

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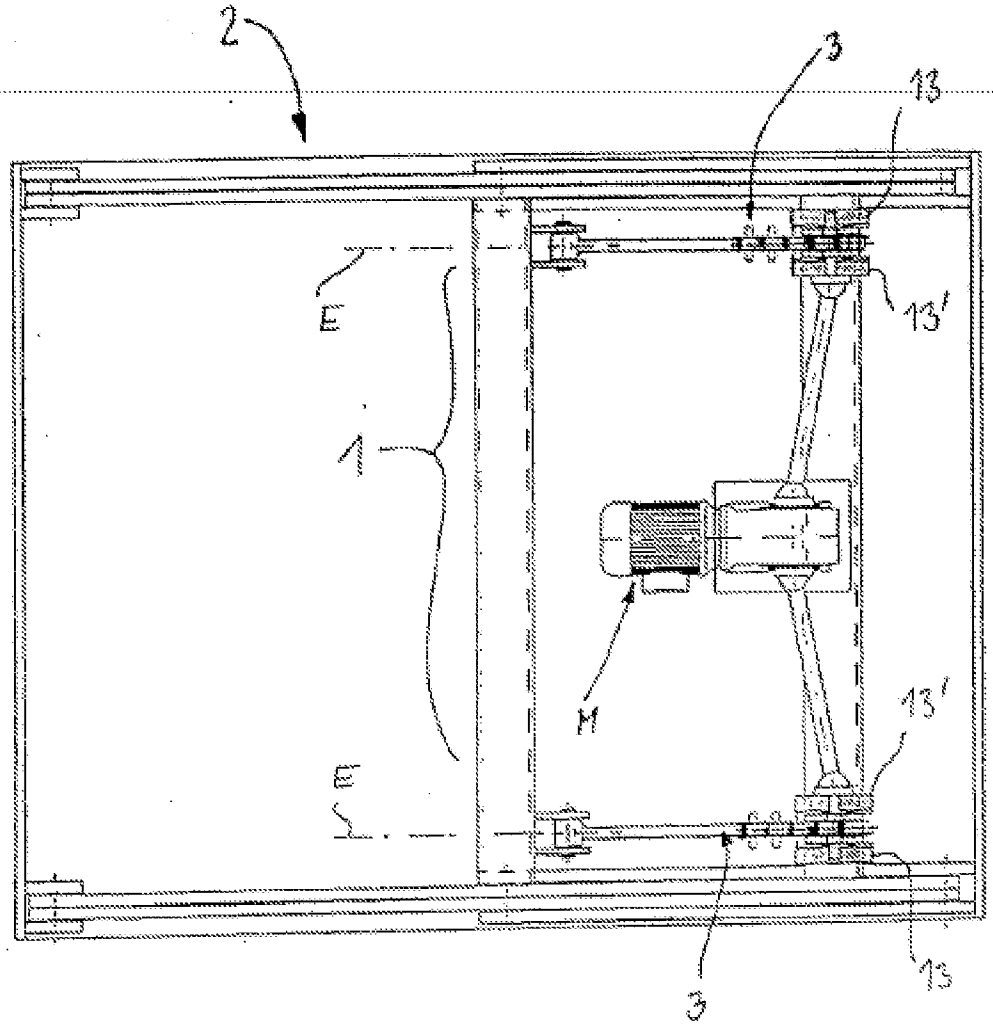


Fig. 3

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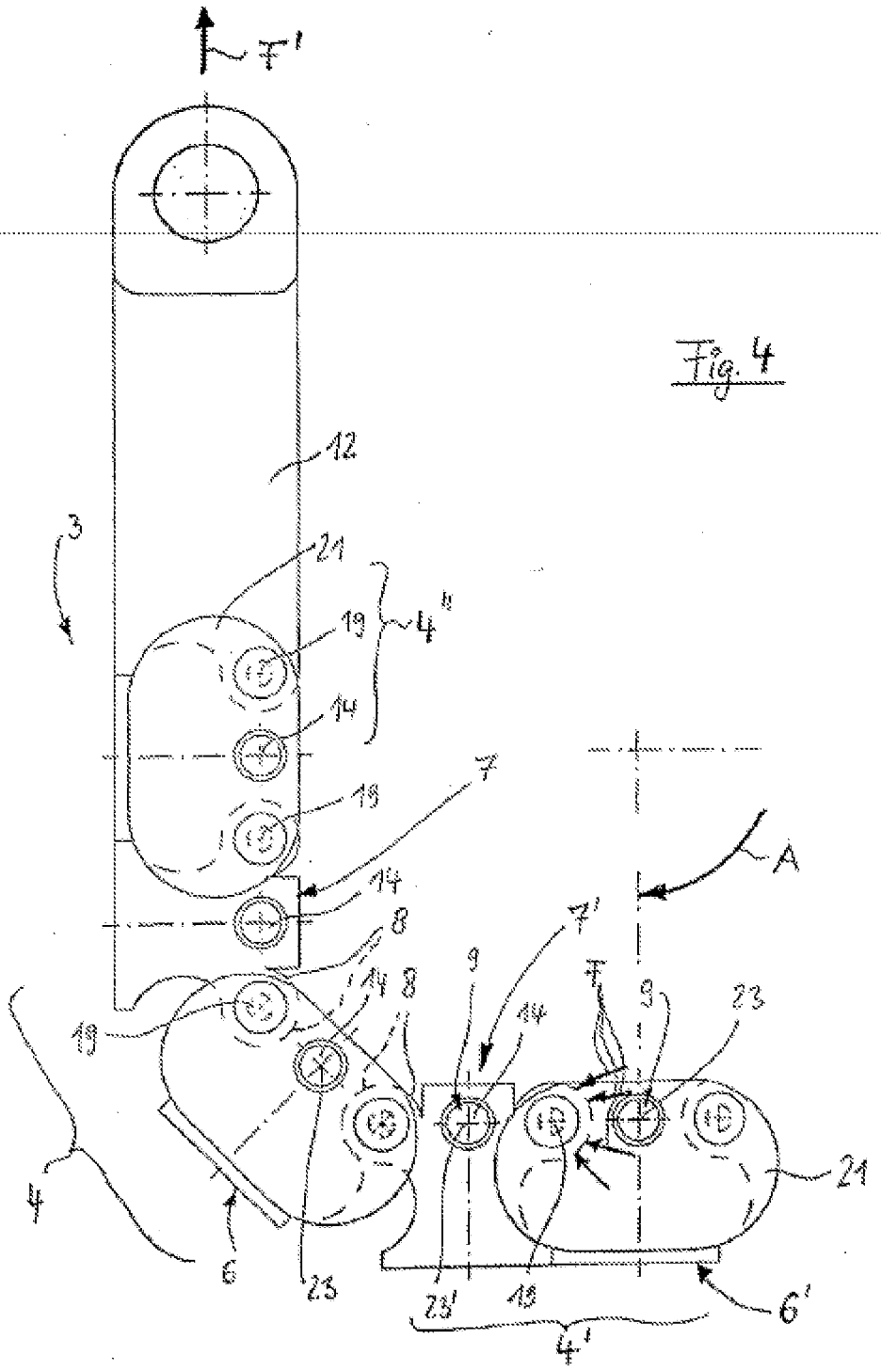


Fig. 4

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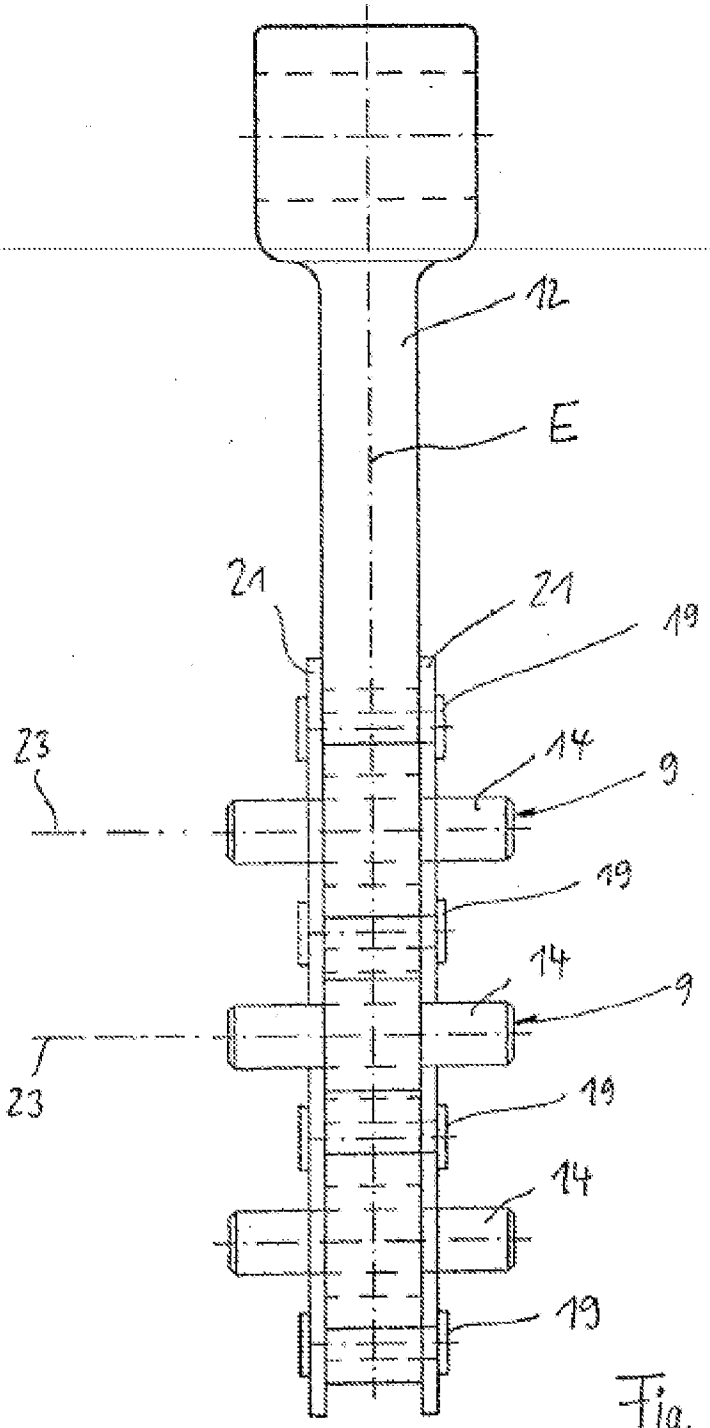


Fig. 5

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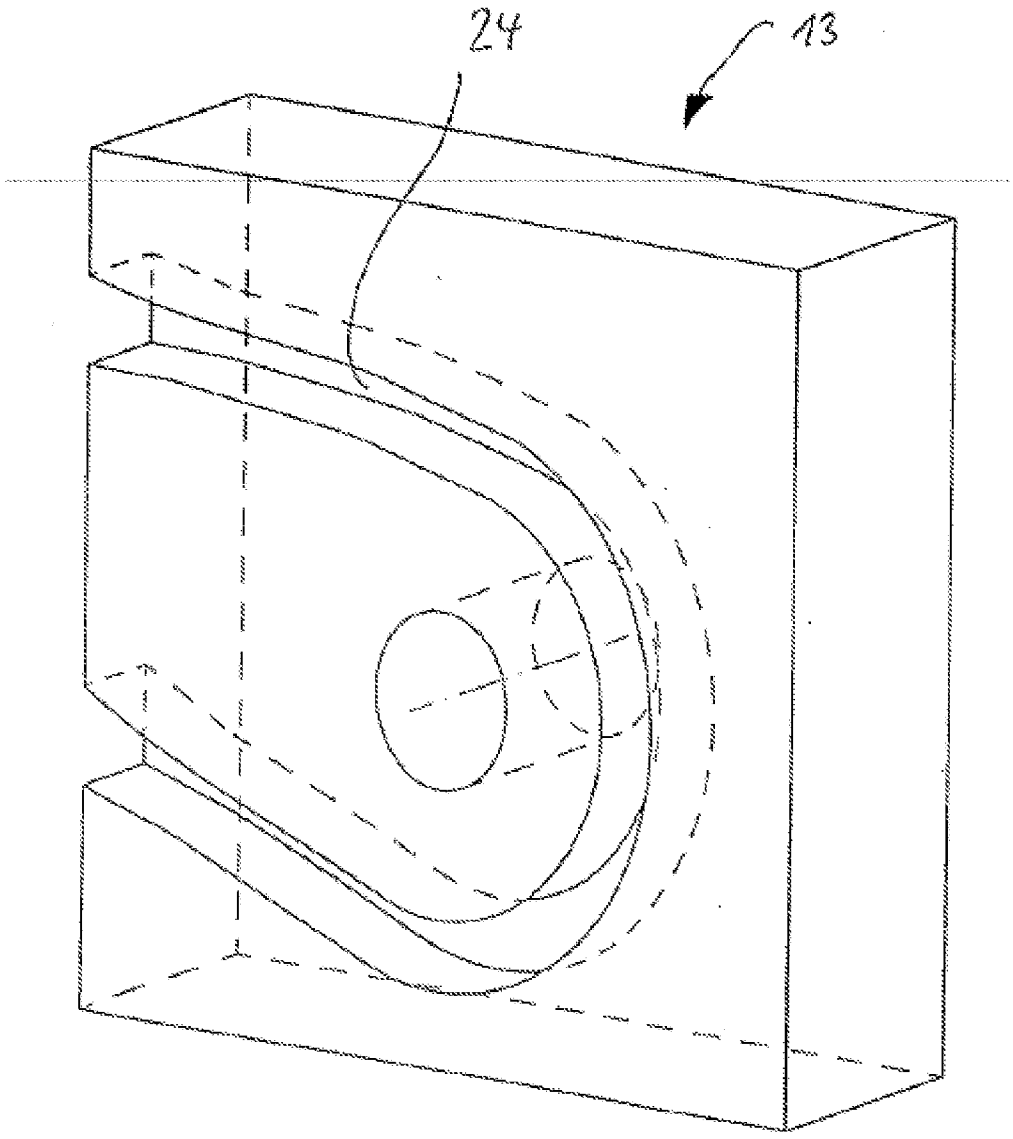


Fig. 6

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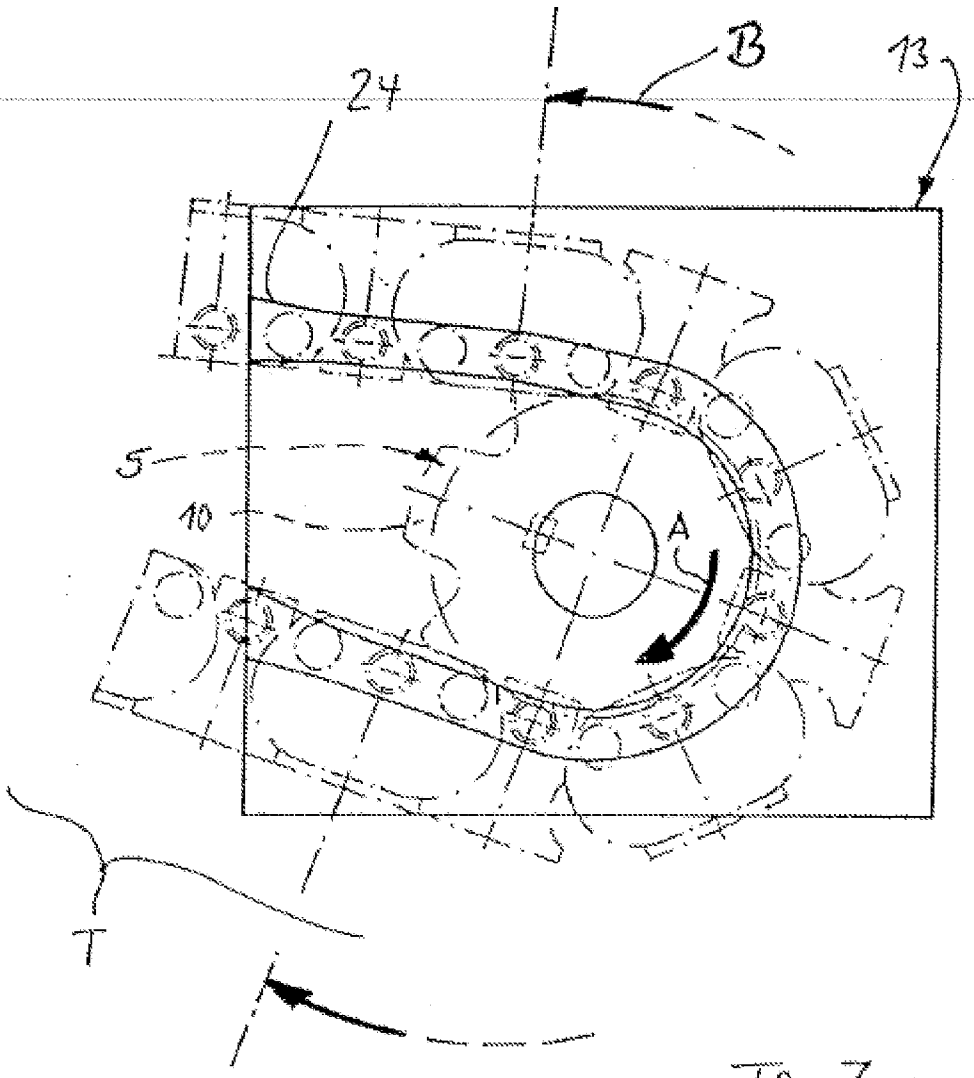


Fig. 7

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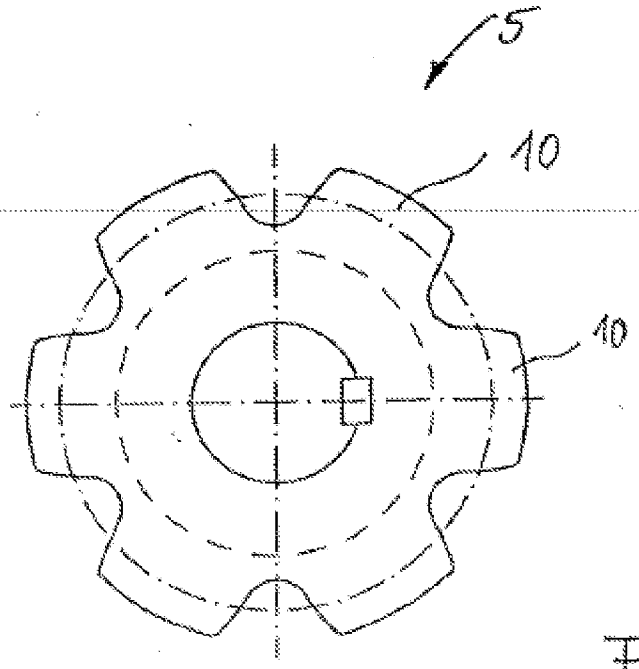


Fig. 8

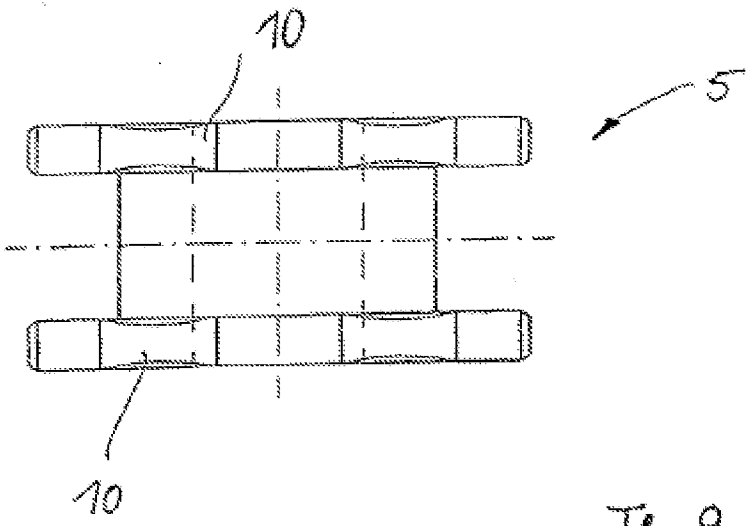


Fig. 9

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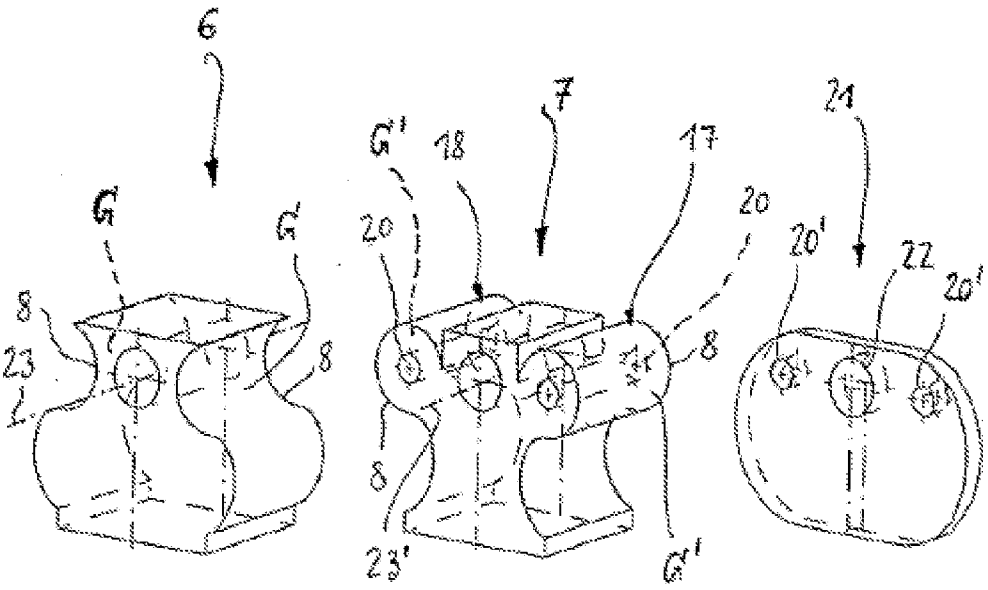


Fig. 10 Fig. 11 Fig. 12

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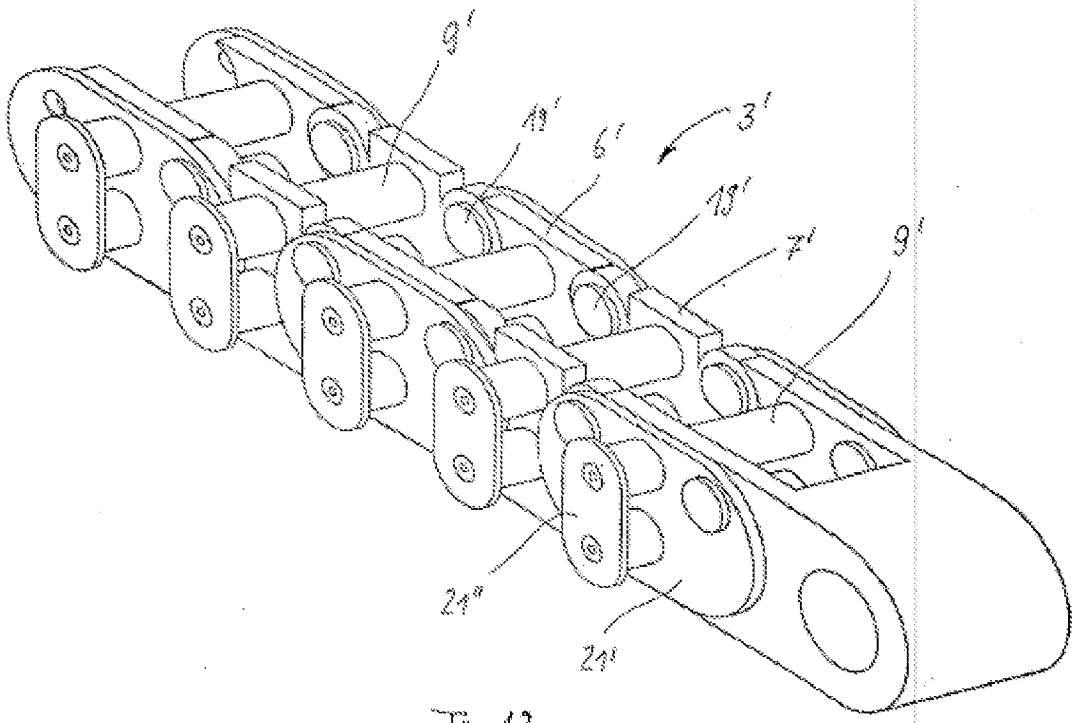


Fig. 13

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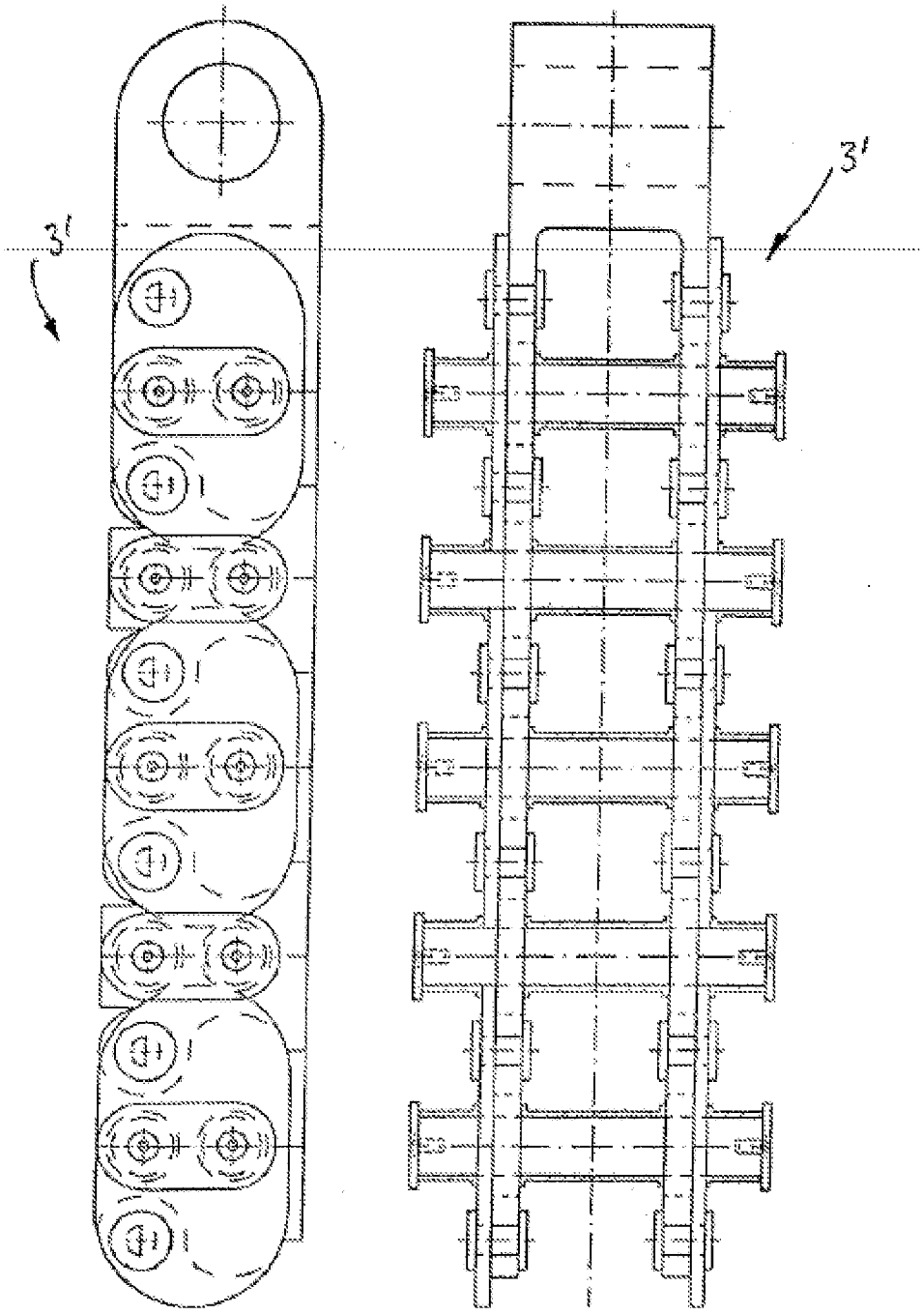


Fig 14

Fig. 15

/17

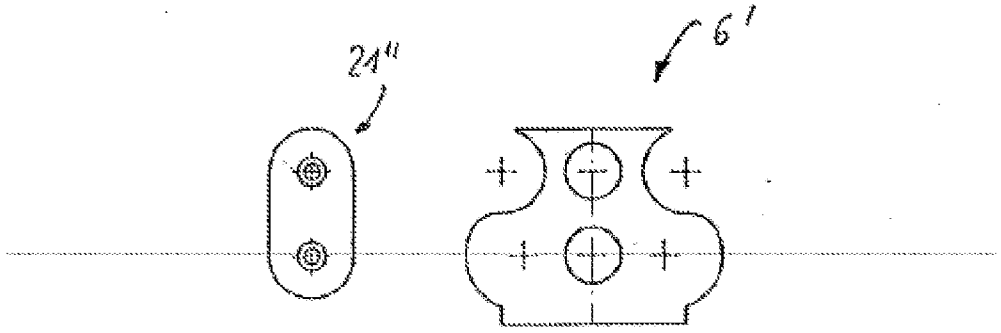


Fig. 16

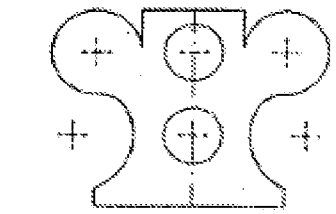


Fig. 17

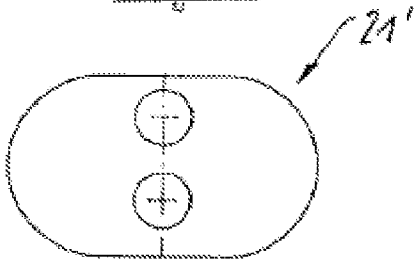


Fig. 18

Fig. 19

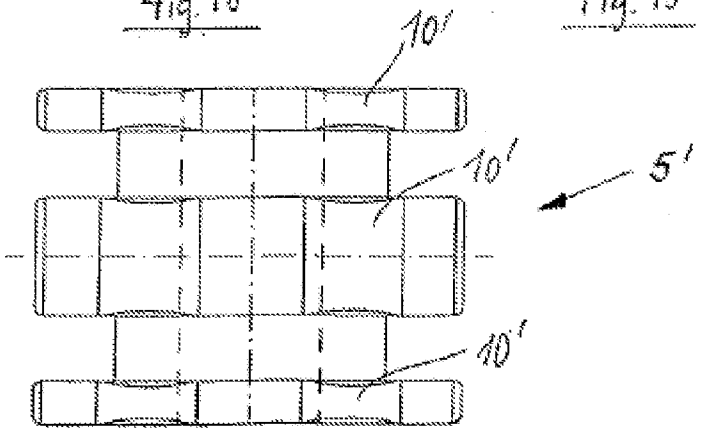


Fig. 20

/18

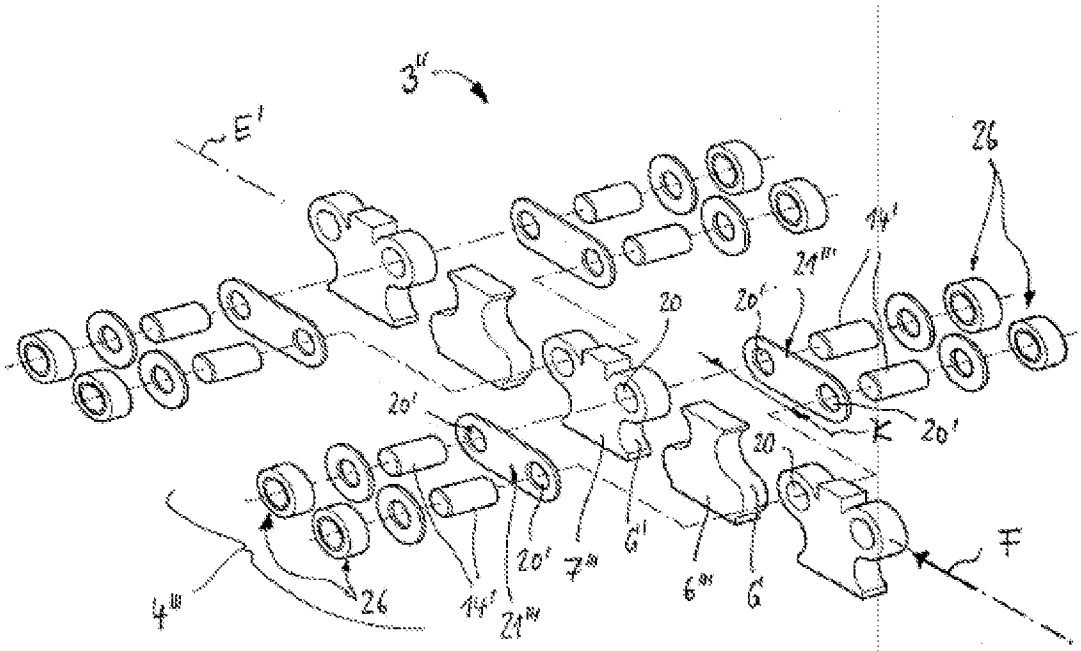


Fig 21

/19

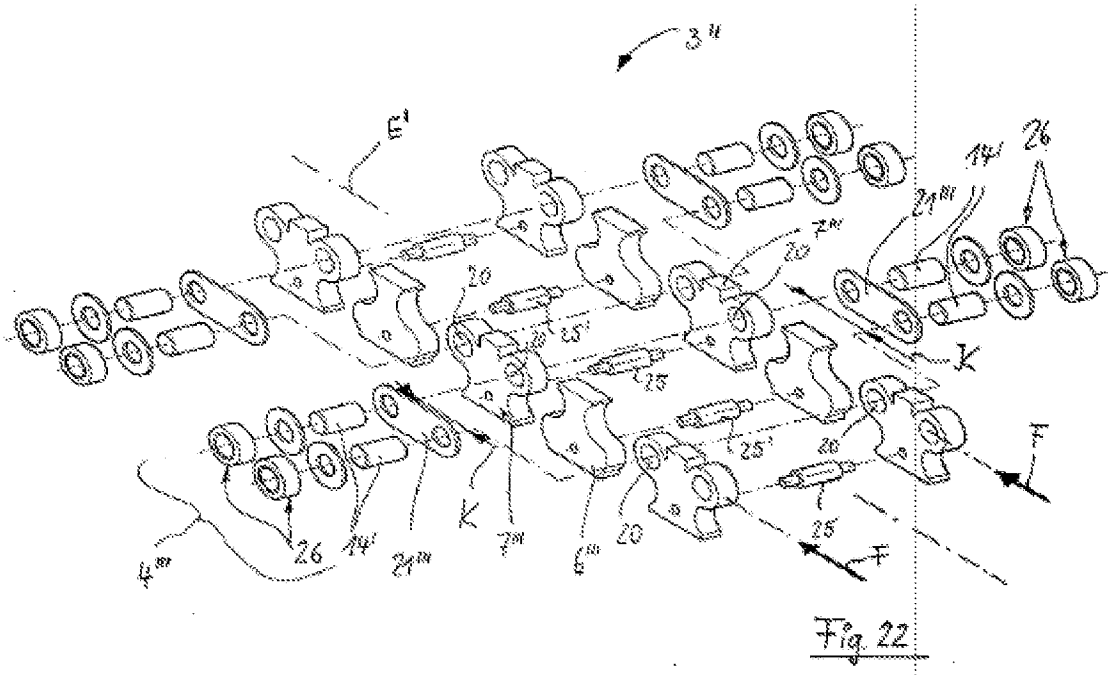


Fig. 22

/20

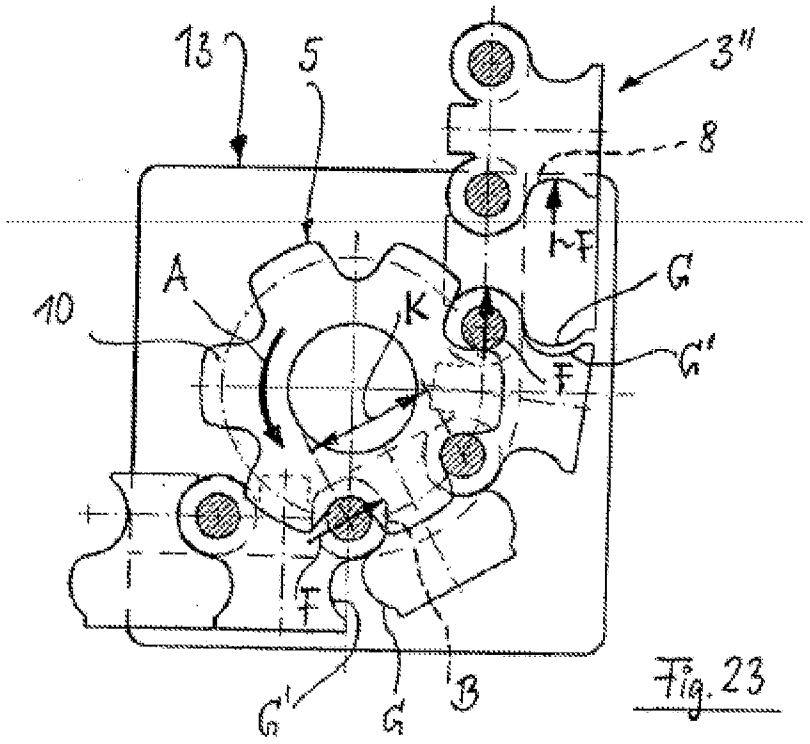


Fig. 23

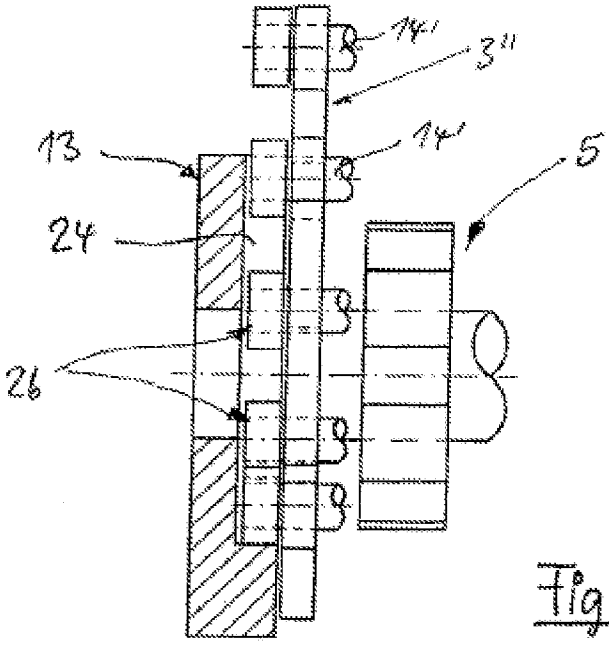


Fig. 24